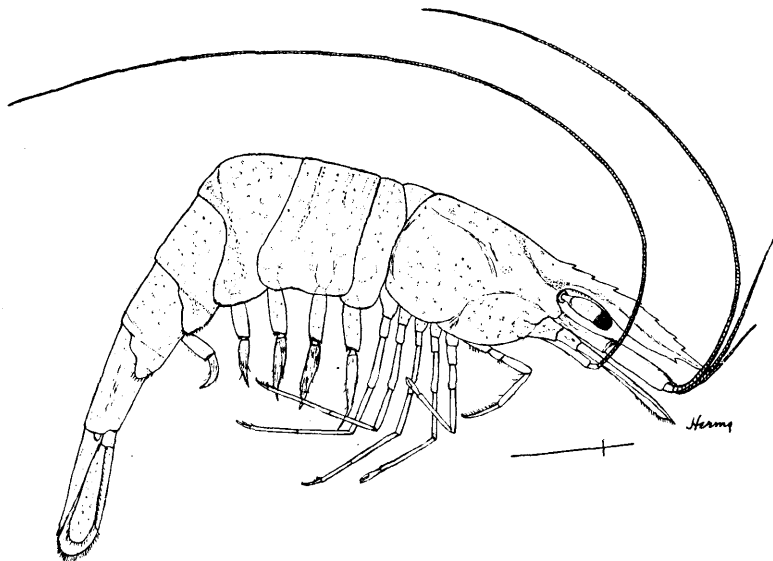


NOTES ON A SANDUSKY BAY SHRIMP, PALAEMONETES EXILIPES STIMPSON.*

WILLIAM B. HERMS.

During the summer of 1904 the writer secured several specimens of *Palaemonetes* for a brief morphological study. These specimens were taken in the waters of Sandusky Bay, Lake Erie, at what is called Black Channel. Before this time specimens had been brought into the Ohio State University Lake Laboratory at intervals, but in some seasons were difficult to secure. During the summer of 1905 not one was brought in. In August of 1906, at the close of the summer session the writer was collecting sponges near Black Channel, when two or three specimens were again unexpectedly taken. This led to a more extended search which resulted in the collection of many specimens, not only in Black Channel but also in the neighboring coves.

FIG. 1. *Palaemonetes exilipes*, Stimpson.

A few of the shrimps collected were sent to the Smithsonian Institution for identification. Miss Mary J. Rathbun, of the Division of Marine Invertebrates kindly identified them as *Palaemonetes exilipes*, Stimpson, widely distributed through the eastern half of the United States excepting New England. Miss Rathbun also stated that this shrimp grows to be two or three

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times the size of specimens sent in, which were about the average of those collected (22 mm. from tip of rostrum to tip of telson).

Besides being apparently rare in Sandusky Bay during past summers, another possible reason why shrimps have not been observed is the transparency of these individuals. They are almost as clear as the water in which they live, and if attention were not called to them, would probably pass notice. Specimens cannot be preserved, it seems, so that this natural transparency may be retained. Placing in alcohol (70 % to 80%) or formalin (4%) caused the specimens to become milky. Those dying naturally in the water also become milky. They can be cleared, however, fairly well in xylol.

The well developed springing power of the shrimp is a frequent cause for losing individuals. These characteristics, viz.: apparent scarcity, transparency, small size and springing power, make the collection of large numbers of shrimps difficult. With a small tow-net, never more than three or four were taken at a time, and frequently none.

This shrimp was first described by Stimpson in 1871 from specimens taken at Somerville, S. C. In 1872 ('73) Smith (S. I.) of the United States Fish Commission described the same species "from half a dozen specimens collected by Mr. J. W. Milner, at Ecorse, Mich., in a grassy arm of Sandusky Bay, Lake Erie, known as Black Channel." As Stimpson's specimens were from Somerville, S. C., and his description differed considerably from the Lake Erie specimens, Smith supposed, at the time his description was written, that the northern specimens represented a distinct species. This error was corrected when the latter received a series collected in the fresh water streams of Florida. Hay, in 1882, reports collecting this species in tributaries of the Tombigbee and Moxubee rivers in eastern Mississippi, in the Mississippi river at Memphis, in Pearl River at Jackson, and in the Chicasawha River at Enterprise, Miss. It is also reported by Forbes for Illinois: "Very common in Illinois River, where it is the only shrimp. Taken in large numbers at Pekin."

The extreme interest of this shrimp and the fact that little or no observations have been made on the behavior of the species, led the writer to observe it more closely.

Their usual habitat is clear, shallow water ranging in depth from one to perhaps four or five feet, with vegetation and sandy bottom. As soon as muddy or mucky conditions were encountered in towing, the shrimps were not to be found. The Sandy coves of Sandusky Bay, Lake Erie, abounding with vegetation, apparently afford ideal conditions and shrimps should be plentiful there. However, the carp and other fish are also plentiful and these undoubtedly feed on the delicate little shrimps. The

latter were found in greatest abundance two or three hundred feet from shore where the water was three or four feet deep. (The coves of Sandusky Bay are as a rule quite shallow). Towing near the surface was unsuccessful, a few were secured at the bottom, but most were taken midway, and somewhat nearer the bottom.

The most abundant vegetation in the coves of Sandusky Bay is included in the following list:

Myriophyllum spicatum L. (Very abundant.)

Vallisneria spiralis L. (Very abundant.)

Ceratophyllum demersum L. (Abundant.)

Naias flexilis (Willd.) Rost & Schmidt. (Abundant.)

Philotria canadensis (Mx) Britt. (Water Weed.) (Very abundant.)

Potamogeton perfoliatus L. (Common; also five or six other species).

Pontederia cordata L. (Pickerel weed.)

Zizania aquatica L. (Wild Rice.)

Scirpus lacustris L. (Great Bulrush.)

Nymphaea advena Soland.

Castalia tuberosa (Paine) Greene.

Nelumbo lutea (Willd.) Pers.

LIGHT EXPERIMENTS.

On Aug. 17, 1906, thirteen shrimps were taken and at once placed in an aquarium two thirds full of water with a few pond-weeds and sand on the bottom. The aquarium was then taken into the dark room. Ten minutes after this it was examined with an acetylene gas lantern and the shrimps were found scattered. Holding the lamp for a moment at one end there was an immediate response, many swimming toward the light. The shrimps were then left in the dark for an hour.

2:46 P. M. Shrimps scattered. Within one minute five responded to the light, coming to the glass. (Light left in position).

2:55 P. M. Ten were at the light end, one within four inches and two at the farthest end. The movement toward the light was not a darting, but a gliding motion. When the glass was reached the motion was continued from side to side, but in one or two minutes the shrimps came to rest.

3:09 P. M. All seemed to be in about the same position.

4:15 P. M. The remaining shrimps were nearer the light. The light end of the aquarium at this time was fairly plastered with pond-snails which happened to be in the aquarium, eleven out of a possible fourteen had crawled up the glass.

4:45 P. M. Only two shrimps remained at the darker end.

6:00 P. M. The shrimps were pretty well scattered again. Those that could be observed had their heads turned away from

the light. An Agrionid larva had been clinging to the glass in front of the lamp for over fifteen minutes. (At this point the lamp was taken away.)

8:00 P. M. Examined again after the aquarium was in the dark for two hours. The shrimps had changed their positions, all but three or four having come to the surface of the water at the margin. On flashing a red light into the water through one end, two shrimps responded at once, the others did not change their positions.

(NOTE.—The aquarium used in the above experiment and the following ones measured 10 x 8 x 6 inches. The sides were covered inside with dense black cloth, ends open; a black focussing cloth served as a cover for the top and one end. An acetylene gas lantern, of bicycle pattern, was used for light, which in the above experiment was simply shed in at the open end. A good red light was secured by screening the face of the lantern with a cap of the best quality tissue paper. Far better results were obtained in the following experiments by cutting off all but a sharp well-defined path. When a full light is shed into the water through the open end of the aquarium, there is a response to the light, but because the water is lighted in comparatively so large an area, the response is rather undecided.)

During the following two days (Aug. 18–19) the aquarium was kept in daylight, *i. e.*, no experiments with artificial light were performed. The shrimps were quite inactive, clinging to the sides of the aquarium and seldom changing position. The darker corners were evidently preferred during the day. This was again apparent when the aquarium was covered with a focussing cloth and a path of sunlight was shed through an aperture in a pasteboard cover placed over one end.

Light experiments applied during the evening of the 19th resulted in no marked or ready response to the stimulus, though the light (artificial) was shed through a small aperture. This inactivity, I think, should be attributed to the fact that the shrimps were in a pathological condition because of the condition of the water, several clams having already died in it. The dragon-fly nymphs (four in number) on the other hand, darted for the light immediately and remained there for the evening excepting occasional excursions away from the light, this but for a moment, then to return and continue bumping against the glass and swimming back and forth from side to side of the light path. Several pond-snails also persisted in coming to the light even after having been pushed aside repeatedly; thigmotaxis, however, eventually carried them straight up the glass and away from the light.

On Aug. 26, 1906, twenty-six shrimps were placed in the aquarium after changing the water and other contents. There was an immediate rush to the light end (daylight), which was repeated again and again on turning the aquarium end for end.

At about 10:30 A. M. it was taken into the dark room, the light or open end being covered with a pasteboard cap having a V-shaped aperture 3-4 inch at the broad end and running to a point in 2 1-2 inches. In a few minutes (five or six), on hasty inspection, the shrimps were found to be scattered among the vegetation. White light shed through the aperture caused four or five shrimps to swim quickly to the light, others following in quick succession. Darkening the water again caused the shrimps to disperse. Red light, violet, blue, orange, indigo, green, and yellow, tried in above succession had a similar effect, *i. e.*, there was a more or less immediate response. There seemed to be a possible preference for red, which the writer has not been able to decide definitely. Colored light caused the shrimps to remain in the field of light better; this is probably due to the greater diffusion of the white light causing a broader and probably less definite field. The shrimps were in the dark room about two and a half hours, and during this time those nearest the light kept up a continual bumping against the glass. From sixteen to twenty shrimps were near the light with from four to twelve bumping the glass within the small area of light. Some seemed to rest on the sand at the bottom, while others kept up the bumping and vice versa.

Taking the aquarium so that sunlight might pass through the aperture now reduced to 3-4 by 3-4 inches, there was no response. The shrimps gradually went back to the pond-weeds or adhered to the sides of the aquarium, with none near the light.

At 7:30 P. M., of the same day (Aug. 26) the light experiments were again repeated, and the shrimps were found scattered throughout the aquarium, clinging principally to the pond-weeds. In two minutes with ordinary lamplight, twenty out of twenty-four (two of the twenty-six had died) were at the open end. Passing the acetylene gas light around the aquarium the shrimps followed it, with only a very faint light showing through the covered sides, making a complete circuit several times.

Using the 3-4 by 3-4 inch aperture again with red, violet, green, blue, orange, and yellow light, practically the same results were secured as above. A rest was given between the use of each color, during which time the shrimps invariably retreated to the pond-weeds. On flashing the light there was an immediate movement toward it, some individuals responding, however, more slowly. Each individual swam to and fro with head touching the glass. Several times it was observed that those which had gone too far into the dark corners, returned to the pond-weeds, but again came back to the light after coming once more in its wake, following a path as indicated by the arrows in the following figure.

With orange light at the aperture and fifteen to eighteen shrimps in the field, white light was placed at the opposite end, removing the orange light at the same time, three shrimps were at the other end (white light) in one minute, and eleven or twelve in five minutes. Changing back again to orange, five shrimps returned in one and one-half minutes and fourteen in five minutes. Experiments were continued in this manner for about an hour and a half with practically the same results, however, yellow light with which experiments were closed did not cause a ready response. This was probably due to the fact that the shrimps were suffering from fatigue, because yellow light used on fresher individuals had the same effect as any other light.

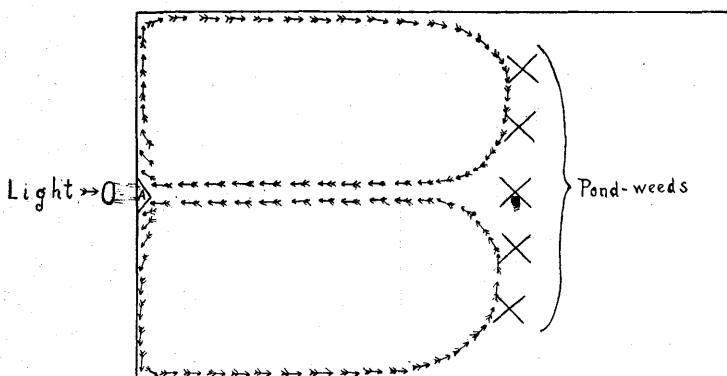


FIG. 2. Diagram showing course taken by some shrimps from pond-weeds to light shed through aperture A in covered end of aquarium. See text for explanation.

Later in the season two apertures were used of equal diameter, (about 3-4 by 3-4 inch), side by side, in the same pasteboard cap and about two inches apart. Two different colors were then used at the same time to test whether there was any preference. It was found by careful observation that there was no apparent choice, except as stated above, a possible preference for red.

(NOTE.—The screen used for colored light was made of the best quality tissue paper from one to three fold depending on the density. This paper was simply placed over the aperture in front of the acetylene gas lantern. The light thus obtained was good for all practical purposes, though great stress should not be placed on details, since the writer was not able to regulate carefully the intensity of the light so as to secure uniform results.)

CONCLUSIONS.—*Palaeomonetes exilipes* Stimpson, is the common shrimp of Sandusky Bay, though not abundant. Shallow water with sandy bottom and rich in vegetation affords the most

favorable conditions. It is strongly, positively phototactic, not only to white light, but to red, green, violet, orange, blue and yellow, showing a probable preference for red.

OHIO WESLEYAN UNIVERSITY,
Delaware, Ohio, November, '06.

LITERATURE CITED.

Forbes, S. A., '76—List of Illinois Crustacea. Bull. Ill. State Lab. N. H., No. 1, 5.

Hay, O. P., '82—Notes on Fresh-water Crustacea. Amer. Naturalist. XVI-(144) 1882.

Smith, Sidney I., '72—Report of U. S. Fish Com. Fresh-water Fisheries of the U. S. Report of 1872-73-A, Synopsis of the Higher Fresh-water Crustacea of the Northern U. S., pp. 641-42.

Stimpson, William, '71, Ann. N. Y. Lyceum N. H., x 130 (Not seen).
